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RESEARCH NOTE NC-73

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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Scleroderris Canker in the Lake States — A Situation Report, 1968

ABSTRACT. — The history of Scleroderris canker in the Lake States Region is reviewed. U.S.D.A. Forest Service studies on the distribution, degree of infection, rate of spread, and general biology of the disease organism are described.

On National Forest land in Upper Michigan and northern Wisconsin, where the disease is most serious, 66 percent of the red pine plantations and 88 percent of the jack pine plantations are infected with *Scleroderris lagerbergii*. In infected stands Scleroderris canker is the main identified cause of tree mortality.

The life cycle of *S. lagerbergii* is described as well as proposed control methods and future studies planned.

OXFORD: 443.2:443.3—172.8 *Scleroderris lagerbergii* **(77)**

In 1951 several red pine (*Pinus resinosa* Ait.) plantations in Upper Michigan began to exhibit poor growth and tree mortality from an unknown cause. By 1960 the problem had expanded to approximately 5,000 acres of red pine and jack pine (*Pinus banksiana* Lamb.) plantations in both Upper Michigan and northern Wisconsin. The fungus responsible for damaging these plantations was identified in 1964 as *Scleroderris lagerbergii* Gremmen, which causes the disease Scleroderris canker. This was the first report of this disease in the United States (Ohman 1966).

Although recognized only recently in the United States, *S. lagerbergii* has a long history of damage to several species of pine and spruce in European forest nurseries and plantations (Bjorkman 1963, Read 1963, and Roll-Hansen 1964). On several occasions the disease has reached epidemic levels in Scotch pine nurseries in Sweden (Kohh 1964).

Since 1964, personnel of the North Central Forest Experiment Station, the Northeastern Area of State and Private Forestry, and Region 9 of the National Forest System have been studying the distribution, degree of infection, rate of spread, and general biology of the causal organism. This paper is a brief summary of that work.

In the Lake States Region, Scleroderris canker damages red, jack and Scotch pine (*Pinus sylvestris* L.) stands. Although the disease is primarily one of planted trees, both natural and planted stands are infected. The problem is most serious in red and jack pine plantations because large acreages have been planted to these species. Black spruce (*Picea mariana*), white spruce (*P. glauca*), red spruce (*P. rubens*), and white pine (*Pinus strobus*) have been found infected with Scleroderris canker in Quebec, but so far no infections in these species have been reported in the Lake States (Smerlis 1968).

In this region Scleroderris canker has been found only in northern Wisconsin and Michigan. In Wisconsin most of the infected plantations have been on the Nicolet and Chequamegon National Forests; only a few infected plantations have been found on either State or private land. In Michigan the infected plantations are primarily in the Upper Peninsula, although there are a few infected plantations in the Lower Peninsula. The heaviest infection areas are on the Ottawa and Hiawatha National Forests, but many State and private plantations are also severely infected.

Based on the evidence now available, it is likely that National Forest plantations were first infected with seedlings received from a nursery in northern Michigan. However, the source of the original infection is not known. Several nurseries and plantations in nearby Ontario are infected with Scleroderris canker, but it is unlikely that their role in the introduction of this disease to the United States can be assessed now.

A 1965 survey of 2- to 10-year-old plantations on National Forest land in Upper Michigan and northern Wisconsin showed 66 percent of the red pine plantations and 86 percent of the jack pine plantations infected with Scleroderris canker (Skilling and Cordell 1966). Severity of infection varied from only a few infected trees to complete kill of trees over large areas from this disease. The disease was most severe on cold and open sites.

To determine the rate of spread of Scleroderris canker within infected plantations on National Forest land, plots in 31 infected red pine plantations have been examined annually since 1966. These plantations were 4 to 10 years old, with 1 to 45 percent of the plot trees infected at the beginning of the study.

Scleroderris canker has increased from 12 to 17 percent in the infected stands during the first 2 years of the study (table 1). How the rate of infection will increase in the future will not be known for some time. Observations of field infection indicate that Scleroderris infection is much greater during "wave years" when environmental conditions are optimum for spore dispersal. The spread study should provide information on this aspect of epidemiology. From 1966 to 1968 Scleroderris canker has been the main identified cause of tree mortality on the 31 plantations sampled.

Table 1. — Increase in Scleroderris canker on infected red pine plantations on National Forests in the Lake States, 1966-68

National Forest	Plantations	Infected trees		
		1966	1967	1968
	Number	Percent	Percent	Percent
Ottawa	8	11	13	14
Hiawatha	8	16	20	22
Nicolet	7	6	7	8
Chequamegon	8	14	22	23
Average	31	12	16	17

The life cycle of *S. lagerbergii* is now fairly well known. Primary infection is by windblown ascospores. These spores are released from fruiting bodies called apothecia during periods of moist weather. Although the spores are disseminated from April to October, most are released during June and July. The ascospores probably germinate on either buds or needles; the fungus later grows through the bud or needle into the branches. Infected branch tips are usually dead by the following summer. These dead branch tips are one of the early signs of Scleroderris infection. The fungus grows down the branch until it reaches the main stem of the tree. On young trees the main stem is girdled quickly, killing the tree within a few months. On larger trees the branch infections may be arrested before reaching the main stem, possibly due to competition from other saprophytic fungi, or the infected branches may be broken off by snow. Stem infections on large trees result in a canker. This canker may eventually be overgrown but frequently will deform the stem. A few months after a branch dies, fruiting bodies called pycnidia appear near the base of the dead needle fasicles. Asexual spores called conidia ooze out of these pycnidia during wet weather. Although not windborne, they can be transported by rain splash to other areas on the same tree, resulting in new infections. These multiple infections lower the vigor of the trees and eventually kill them. Apothecial fruiting bodies appear in early summer on branches that have been dead for 1 to 2 years. The apothecia are also usually found at the base of dead needle fasicles and are often closely associated with the pycnidial stage. The ascospores mature from late April to June and are discharged following rainfall.

The tree mortality now occuring in our red pine plantations is probably the result of a small number of infected trees present in the nursery stock when the plantations were established. These trees have produced the inoculum for subsequent infection of the remaining stand. A controlled burn study was established in 1966 to determine whether Scleroderris canker could be eradicated from an infected plantation. The area was broadcast burned before replanting with healthy stock. Unfortunately, the results were inconclusive, primarily because infection was too sparse in the original plantation. Tests are now underway to determine whether manual removal of infected trees from plantations will reduce the rate of spread.

Several nurseries located in areas where Scleroderris canker is present are now testing the fungicide maneb to prevent nursery infection. Other fungicides are also being field tested as alternatives to maneb for protecting nursery stock. Some of these chemicals are highly toxic to *S. lagerbergii* and may be valuable for future use.

In addition to sanitation studies and tests of nursery fungicides, research is in progress to determine how the spores of the fungus enter the host tree and what environmental factors are related to infection. The Forest Pest Control Division of State and Private Forestry will continue to evaluate the spread of Scleroderris canker in infected areas to determine the effect of this disease on red pine plantations. Also, plans are to determine whether the inoculum sources that have accumulated in past years in infected areas present a threat to new plantations when the trees are no longer protected by nursery spraying. And finally, an effort will be made to more precisely evaluate the impact of Scleroderris canker on the National Forest planting program by determining how many plantations have failed due to the disease.

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